

## No Bad Apples!

Dealing with Apple  
Pests in the Home  
Garden



Plant, Soil & Insect Sciences

## Basic questions

- Why do I want these apples?
- Ultimate use determines “damage tolerance”
- Sales vs. personal
- “Kissed by nature”



## Tackling Management of Apple Diseases

- The rationale and reality of pest management
- Know your adversaries – a rogues gallery of diseases of apples
- The toolbox – methods of pest management in general
- Applying tools to management

## Ultimate use of apples matters

- Cider doesn't require blemish-free apples
- “Cyder is their common drink” Lord Gordon on the New England colonists
- Pies, apple butter, sauce



## Historic perspective

- Within last 120 yrs., farmers began to use chemicals to treat fungal plant diseases
- Solutions of sulfur, or copper, lime and oil (Bordeaux mix)
- Developed for grapes, but useful against apple scab
- Could produce more fresh, high quality fruit



## Historic perspective

- 1900 - growers averaged 2 or 3 fungicide applications per year
- Decreased damage from 50 to 100% to more like 25 to 50%
- 1940's - averaged 18 sprays and still suffered over 10% crop damage



## Controlling nature

- 1950's and 60's emphasis was on "clean fruit"
- "Sterilize" the orchard
- Americans came to expect unblemished fruit



## Fungicide dependence

- Fungicides allowed growers to produce relatively disease susceptible varieties
- Market expected & paid most for unblemished fruit
- To market fruit, commercial growers must control diseases



## Before fungicides

- Orchards from cider pomace
- John Chapman
- Seedlings common, but good varieties grafted
- Roxbury Russett, Westfield Seek No Further, Rhode Island Greening, Sheepnose, Winter Banana, Esopus Spitzenberg...



## Transition period

- Over 14,000 varieties of apples in the 1800's
- By 1915, 24 varieties - 80% of U.S. apples
- By 1964, 10 varieties - 80% of crop
- By 1990, 7 varieties - 80% and two varieties, Delicious and Golden Delicious >50%



## Back to basic questions

- Why do I want these apples?
- Ultimate use determines "damage tolerance"
- Sales vs. personal
- Kissed by nature



## Basic questions

- Do I want to use organic methods? Why?
- Take care of my land and the environment
- To have food that doesn't have residues of standard pesticides
- Work with nature, rather than trying to subdue it



## We always have options

- Do nothing - most domesticated apple cultivars won't last long
- Spray a lot with standard chemicals - older commercial approach
- Spray less with standard chemicals integrated with other controls - IPM approach
- Spray with organic chemicals integrated with other controls - organic approach

Low

Amount of work

High



## Key apple disease(s)



Apple Scab

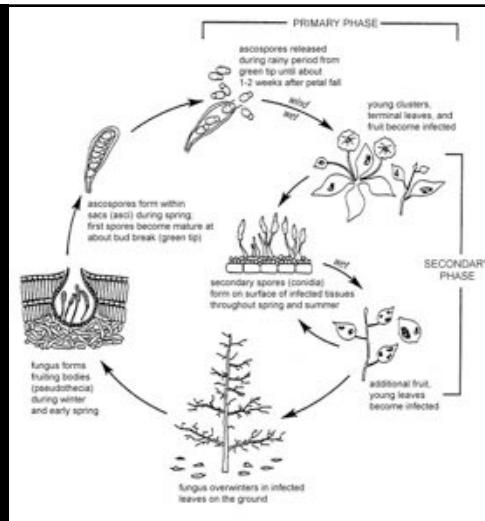
- The rest ...
- Rusts
- Powdery mildew
- Fire blight
- Fruit rots
- Sooty blotch/flyspeck

## Understand pathogen biology: know when risk is high

DISEASES	MAR	APR	MAY	JUN	JUL	AUG
Apple Scab		P		S		
Powdery Mildew		P		S		
Fire Blight			P	S		
Fly Speck, Sooty Blotch				P	S	

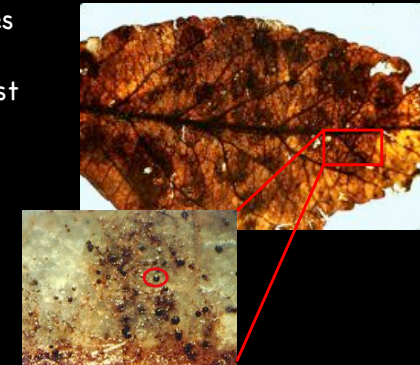
- P = primary infection - the first infections
- S = secondary infection - the later infections during the year

## Disease cycle: apple scab



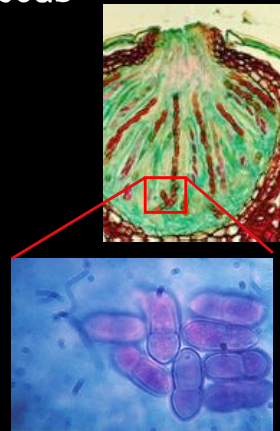
## Disease cycle: apple scab

- In spring, scab fungus produces spores
- Apple trees just producing new leaves



## Disease cycle: apple scab

- Spores produced in fruiting bodies
- Released with rain
- Float into the air
- Contact new leaves



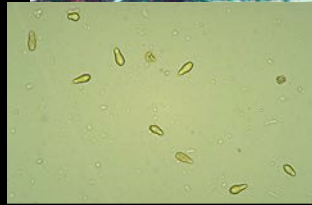
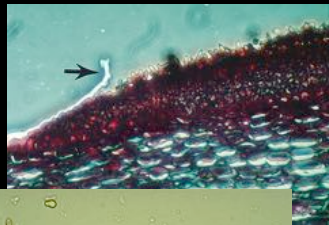
## Disease cycle: apple scab

- Spores infect young leaves
- Hyphae grow
- Fungus produces different kind of spores
- Conidia



## Disease cycle: apple scab

- Conidia are asexual
- Released in rain
- Cause more infections
- Secondary cycle
- Repeats



## Disease cycle: apple scab

- Lesions darken
- Leaves may die
- Fruit infected



## Disease cycle: apple scab



- Wet season causes defoliation
- Leaves on ground with fungus

## Disease cycle: apple scab

- For fruiting apples, fruit destroyed



## Types of IPM tools

Chemical

Resistant  
cultivars

Cultural  
controls

Biological  
controls

Forecast  
models



## Types of IPM tools

Resistant  
cultivars



## The easiest way to control scab

- Many scab resistant cultivars
- Topaz
- Liberty
- Redfree
- Goldrush
- Prima
- Jonafree
- Enterprise
- Williams Pride
- Dayton



## Potential problem

Topaz with scab  
from new apple  
scab race



## Resistance to diseases

- Need to either plant, or graft to establish trees
- Varieties are different from familiar cultivars
- Not resistant to all diseases
- Not resistant to insects



Liberty

## Disease resistance

- None resistant to summer diseases
- Some are resistant to mildew, rust and/or fire blight
- Don't forget rootstocks - resistance to fire blight important



## Finding resistance

- Domestic apple, *Malus x domestica*, probably originated in Khazakstan
- *M. domestica* is a natural hybrid of several *Malus* species that probably crossed in this melting pot



## Apples want to be eaten



Apple forests have significant genetic diversity. Animals, such as bears, eat fruit and seeds are spread.





## Prospecting for resistance



Examining apples on wild trees, later collected, sorted and labeled for seed removal.



## Types of IPM tools

Cultural controls



## Scab initial inoculum

- Scab epidemics start on the orchard floor
- Most scab spores don't travel more than 100 ft.
- Remove wild or unsprayed trees near orchard border



## Getting rid of initial inoculum

- Remove fallen infected leaves in fall or very early spring
- Rake
- Mower to chop into small pieces
- Nitrogen or compost application in spring



## Types of IPM tools

Chemical

Resistant cultivars

Cultural controls

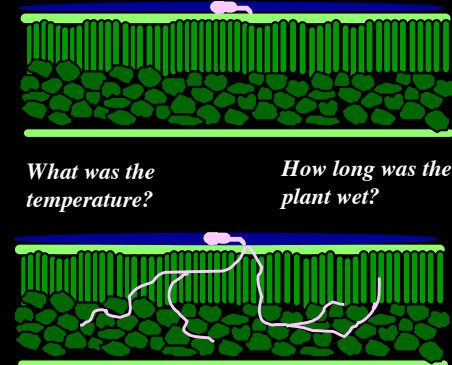
Biological controls

Forecast models



## Biology of scab infection

- Mills Periods
- Wetting periods
- Developed to tell when an infection had happened



## Infection times change as the temperature changes

It rains for 48 hours:

### Mills Periods

Temp. Hrs. Wet

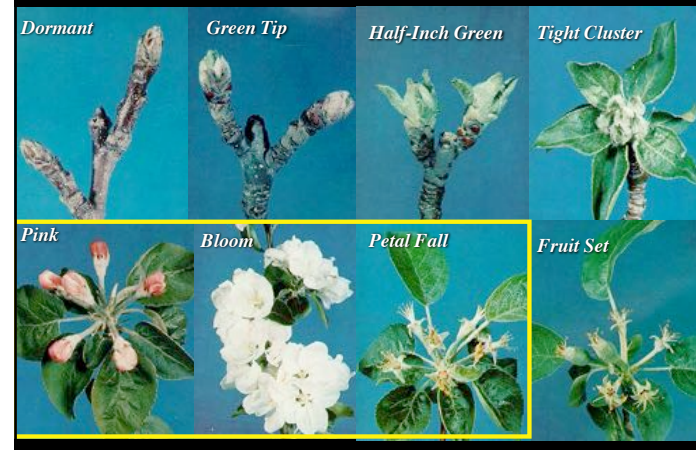
34	70
44	25
54	13
64	9
74	9

If the average temperature is 44, is there an infection?

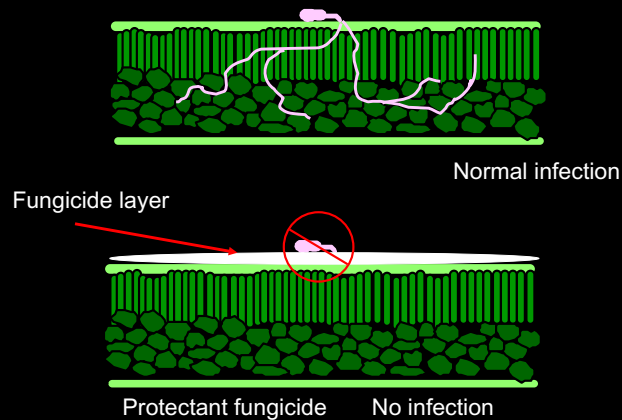
If the average temperature is 34, is there an infection?

If the average temperature is 64, is there an infection?

## Growth stages and fungicides



## What do fungicides do?



## Keep it organic, keep it simple

- Sulfur
- An effective, protectant, fungicide
- Short activity span
- Liquid forms easier to use than powder/dry formulations
- Must be applied before a scab infection period

## Alternative organic – green tip

- Copper – can damage fruit
- Broad spectrum biocide
- Bordeaux Mixture
  - copper plus hydrated lime and oil
- Target – powdery mildew, black rot

## Fungicides

- Lime sulfur
- Used if sulfur didn't go on before rain
- Apply within 48 hrs. of start of rain
- Liquid form – smelly
- If used frequently can damage trees

## Fungicides

- Captan
- Very effective against apple scab, rots, summer blemishes
- Bonide: captan 50W
- Dragon: captan
- Ortho Home Orchard Spray: captan plus insecticide
- Protects

## Fungicides

- Mancozeb
- Moderately effective against apple scab; good against rust
- Bonide: mancozeb
- Dragon: mancozeb
- Protects

## Experimental organic fungicides

- Potassium bicarbonate
- Kaligreen
- Also Armicarb, but it hasn't gotten OMRI approval
- Phosphorous acid a.k.a. phosphite
- Phosphorous acid is not phosphoric acid
- AgriFos, Phostrol

## Experimental

- Hydrogen peroxide
- A strong oxidizer, disinfectant
- Can do the same on plant surfaces
- Does not last long
- No protection
- Oxidate



## Fungicide rates\*

	1 Gallon	10 Gallon	100 Gallon
Copper Sulfate	1 Tbsp. 1.6 oz.	1 lb.	
Lime Sulfur Gallon		.65 fl.oz.	6.4 fl.oz. ½
Sprayable Sulfur	3.4 oz.	1.2 lb.	5 lb
Captan (50W)	2 Tbsp	3.2 oz.	2 lb

\*The label is the law! Always read and follow it.

## Fungicides can control more than one disease

Tree Fruit/Disease	Bordeaux mixture	Captan	Chlorothalonil <sup>1</sup>	Liquid copper	Ferbam <sup>2</sup>	Lime sulfur	Mancozeb <sup>4</sup>	Sulfur <sup>3</sup>	Neem oil <sup>5</sup>
<b>Apple and Pear</b>									
Fireblight	X			X					
Powdery mildew						X		X	X
Rust					X		X	X	X
Scab	X not pear	X not pear			X	X	X	X	X

## Cedar apple rust

- Has two hosts
- Apple and juniper (Eastern red cedar)



## Cedar apple rust



## Powdery mildew

- Initial inoculum in buds
- Multiple infections per year



## Management of mildew

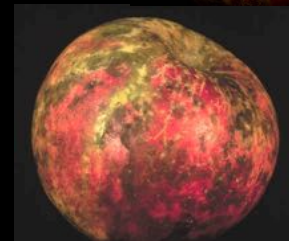
- Use least susceptible or resistant cultivars
- For ex., don't plant Ginger Gold if mildew is an issue!
- Remove obviously infected shoots ASAP.
- Spray with sulfur or bicarbonates
- Pink, petal fall, first cover

## Mildew and rusts infections coincide with scab

- Scab sprays with sulfur will generally slow or control powdery mildew
- Sulfur won't control rust
- No good organic fungicide for rust control

## Summer blemishes sooty blotch and flyspeck

- Just a blemish on the surface of fruit
- Keep trees well pruned for good air circulation



## Clean it off

- Can soak in a 5 to 10% bleach solution for ~ 5 min.
- Rinse, and rub off with a cloth



## Rots may be a problem

- Usually black rot
- Most critical period is at petal fall and fruit set
- Remove old, dead wood
- Remove mummies



## Fire blight

- Attacks a number of plants in the rose family
- Pear and apple



## Fire blight symptoms: overwintering canker



## Fire blight infects blossoms



## Fire blight





## Fire blight spreads in tree

- Canker spread.
- Throughout the summer, bacteria can continue to spread into the main trunks and tissue of trees
- Rootstocks



## Fire blight difficult to manage

- Prune out any cankers in winter
- If it hits, prune out branches well in front of visible infection – go to next branch junction
- Commercial growers use streptomycin
- Resistant cultivars